(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
22 November 2001 (22.11.2001)

PCT

(10) International Publication Number
WO 01/89245 A1

(51) International Patent Classification[7]: H04Q 7/32, H04B 1/40

(21) International Application Number: PCT/EP01/03128

(22) International Filing Date: 20 March 2001 (20.03.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0011744.0 17 May 2000 (17.05.2000) GB

(71) Applicant *(for all designated States except US)*: **ROKE MANOR RESEARCH LIMITED** [GB/GB]; Roke Manor, Old Salisbury Lane, Romsey, Hampshire SO51 0ZN (GB).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **DOMOKOS, John** [GB/GB]; 3 Millbrook, Salisbury, Wiltshire SP1 1NH (GB). **ARMSTRONG, Sian** [GB/GB]; 72 Briarswood, Shirley, Southampton, Hampshire SO16 6GD (GB).

(74) Agents: **FRENCH, Clive** et al.; Siemens Shared Services Limited, Siemens House, Oldbury, Bracknell, Hampshire RG12 8FZ (GB).

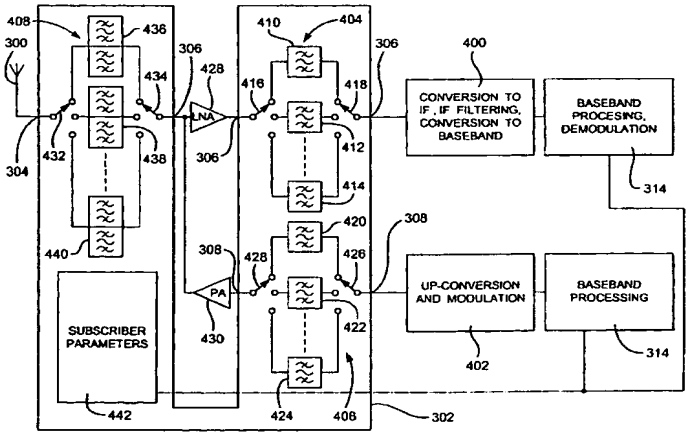
(81) Designated States *(national)*: AU, JP, US.

(84) Designated States *(regional)*: European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: ADAPTIVE TERMINAL ARCHITECTURE



(57) Abstract: With the large number of mobile telecommunications systems in existence, there is a need to provide a terminal, known as an adaptive terminal, which can operate in these mobile telecommunication systems. Current terminal are dual/tri-band cellular telecommunication handset which have a chip set to facilitate operation within 2/3 bandwidths. However, the realisation of a handset capable of operating in 4 or more telecommunication systems is difficult, because the chip set supporting such a configuration would be extremely complex; the arrangement of filters in the receive and transmit chains would be complex. The present invention therefore provides a simplified handset structure which is a broadband structure, the circuit topology and design parameters therefore enabling the provision of filter modules which can easily be provided on a SIM card, or within the hand set itself. The advantage of such a system is that it allows the filtration elements to be produced as a module without increasing the overall complexity of the handset architecture.

WO 01/89245 A1

ADAPTIVE TERMINAL ARCHITECTURE

The present invention relates to a communications terminal of the type that can operate in accordance with a number of telecommunication standards supported by a number of cellular communication systems.

A user of a mobile terminal has varying requirements depending upon where the user lives and travel habits of the user. At present, it is impossible to roam world-wide using a single mobile terminal, because present Second Generation and imminent Third Generation mobile communication systems support incompatible telecommunication standards. Consequently, in order to make a truly universal mobile terminal capable of operating world-wide, the universal terminal needs to be able to support all present and future telecommunication standards.

Since it is impossible to foresee all possible future telecommunication standards that may immerge in the forthcoming years, it is necessary to ensure that the universal mobile terminal is based upon a flexible, software-based technology platform in order to achieve global roaming. Adaptive terminals are an example of the universal mobile terminal based upon a software-based technology platform.

Adaptive terminals have hardware which is reconfigurable by means of a standardised software download method. By downloading telecommunication standard-specific software to the adaptive terminal, the adaptive terminal is able to adapt to different, or changing, standardisation requirements, in particular, radio access techniques and different service requirements.

However, the adaptive terminal has to operate in a range of frequencies between about 810 to 2200 MHz. Consequently, in order to operate over all of this range of frequencies whilst meeting all the specifications of a required telecommunication standard, a Radio Frequency (RF) front end of a receiver of the adaptive terminal has to be very broad-band, i.e. operate in the range of frequencies between about 810 to 2200 MHz.

In particular, an adaptive terminal having filters before conversion to intermediate frequency (IF) in the front end and a duplexing filter after an antenna (for Frequency Division Duplex (FDD) standards) capable of providing filtering operations in respect of all present telecommunications standards would be very complex and cumbersome in structure. Furthermore, any compromise with regard to complexity or size may impact upon the performance of the adaptive terminal. Therefore, even if it were possible to provide such filtering in the adaptive terminal, there would be no guarantee that the terminal would operate to a satisfactory standard in relation to future telecommunication standards.

It is therefore an object of the present invention to obviate, or at least mitigate, the above-described disadvantages in connection with adaptive terminals.

According to a first aspect of the present invention the present invention, there is provided a communication terminal comprising a broad-band transceiver and a filtering module specific to at least one communication standard, wherein the filtering module is removably coupleable with the broad-band transceiver.

For the avoidance of doubt, it should be appreciated that the transceiver can be filterless, or can include at least one filter, provided that the at least one filter is not unique to the at least one communication standard.

Preferably, the filtering module is part of a data carrier. More preferably, the data carrier is a smart card. Very preferably, the smart card is a Subscriber Identity Module (SIM).

Preferably, the filtering module comprises at least one receiver filter, at least one transmitter filter. The filtering module may also comprise at least one duplexing filter.

Preferably, the terminal further comprises a first selection means for selecting at least one of the at least one receiver filters.

Preferably, the terminal further comprises a second selection means for selecting at least one of the at least one transmitter filters.

Preferably, the terminal further comprises a third selection means for selecting at least one of the at least one duplexing filters.

According to a second aspect of the present invention, there is provided a data carrier comprising a filtering module specific to at least one communication standard, wherein the filtering module is removably coupleable with a communication transceiver.

According to the present invention, there is also provided a method of operating a communication terminal comprising: coupling a data carrier to the communication terminal, and powering-up the communication terminal, the method being characterised by the steps of: providing a filtering module with the data carrier, the filtering module being specific to at least one communication standard.

Preferably, the method further comprises the steps of: selecting a communication network, and selecting filters within the filtering module to enable operation of the communication terminal in accordance with a communication standard from the at least one communication standard corresponding to the communication network selected.

It is thus possible to provide a communications terminal capable of operating over a wide range of frequencies between about 810 and 2200 MHz, whilst being capable of providing telecommunication standard specific filtering for operation within a particular sub-band of the wide range of frequencies.

Consequently, when a user first purchases the communication terminal, the user is provided with a SIM card having the filtering module arranged to provide filtering operations to enable the handset to operate in accordance with the Global System for Mobile Communications (GSM), Personal Communications System (PCS) and IS-95 standards, thereby providing the user with the ability to use the communications terminal in Europe and the USA. Should the user need the communications terminal to operate in accordance with a different telecommunications standard, the user simply needs to contact a service provider from whom the communications terminal was purchased in order to obtain a new SIM card having a filtering module capable of providing the filtering necessary to enable the communications terminal to operate in accordance with the different telecommunications standard.

By providing standard specific filters capable of being separated from the rest of the transceiver hardware, the communications terminal becomes a fully universal mobile terminal which can be software configured to operate

in accordance with any telecommunication standard, i.e. an adaptive terminal. Hence, the size of the communications terminal can be kept to a minimum, because hardware specific to supporting standards which are not required by the user is not incorporated into the communications terminal. Additionally, the design of the transceiver hardware for the communications terminal becomes common, thereby reducing manufacturing costs. Of course, the user must subscribe to a network supporting the telecommunication standard and possess the correct SIM card having the appropriate filtering module.

At least one embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic diagram of a cellular communications system capable of supporting an embodiment of the invention;

Figure 2 is a schematic diagram of a base station used in the cellular communications system of Figure 1;

Figure 3 is a schematic diagram of a terminal constituting an embodiment of the invention:

Figure 4 is a schematic diagram of the terminal of Figure 3 in more detail, and

Figure 5 is a flow diagram of the operation of the terminal of Figures 3 and 4.

Throughout the following description like parts will be identified by identical reference numerals.

In a cellular telecommunications system, for example, a GSM system 100 (Figure 1), a base station 102 supports a geographical area, or cell 104,

the base station 102 being in communication with a mobile handset 106 via a radio frequency (RF) interface 108.

As an example only, communications between the base station 102 and a Public Switched Telecommunications Network (PSTN) 110 can be supported by any telecommunications architecture 112 known in the art. A fixed-line telephone 114 is also coupled to the PSTN 110.

It should be appreciated that although reference has been made above to a particular type of handset, other terminals can be used instead of the base station 102 or the handset 106, including, for example, fixed cellular terminals, or laptop computers/Personal Digital Assistants (PDAs) suitably adapted to function within the GSM system 100. Similarly, although the fixed-line telephone 114 coupled to the PSTN 110 has been described above, other communications devices are envisaged, for example, a personal computer (PC) and a modem, or another mobile handset.

The base station 102 (Figure 2) comprises a base station antenna array 200 coupled to a base station duplexer 202. A first terminal of the base station duplexer 202 is coupled to a base station microprocessor 204 via a base station transmitter chain 206. Similarly, a second terminal of the base station duplexer 202 is coupled to the base station microprocessor 204 via a base station receiver chain 208.

The base station microprocessor 204 is coupled to a base station RAM 210. Information is communicated to and from other parts of the cellular network (not shown) by means of an I/O interface 212 coupled to the base station microprocessor 204.

Referring to Figure 3, the handset 106 comprises a front end portion, P_{fe}, and a baseband portion, P_{bb}. The front end portion P_{fe} comprises a

broad-band receiver front end 310, a broad-band transmitter front end 312, and a data carrier, for example, a smart card such as a subscriber identity module (SIM) card 302. The SIM card 302 is adapted to have a first filter port 304, a second filter port 306 and a third filter port 308. The second filter port 306 and the third filter port 308 are coupled to the broad-band receiver RF front end 310 and the broad-band transmitter RF front end 312. The receiver front end 310 and the transmitter front end 312 are coupled to a base-band unit 314, constituting the base-band portion P_{bb}. The functionality of the receiver front end 310, the transmitter front end 312 and the base-band unit 314 is carried out by a microprocessor 315. A display 316, the speaker unit 317, the keypad 318 and the microphone 320 are each coupled to the microprocessor 315. An antenna array 300 is coupled to the SIM card 302.

The SIM card 302 contains a computer (not shown) and a memory chip (not shown). The SIM card 302 is the size of a credit-card or can also take the form of a cut-down version to fit into smaller handsets. For GSM, the SIM card 302 contains subscriber parameters, holds personal data used by the subscriber, holds subscriber personal telephone numbers, identifies the subscriber to the network, provides security via a Personal Identification Number (PIN), retains information on the last cell in which the phone was operated, frequency of base channel and cell location, as well as stores short messages from the network. The most important function of the SIM card 302 is to identify the subscriber to the network for various known purposes, for example, billing and determining privileges of the subscriber. The SIM card 302 is essential for making non-emergency use of the handset 106.

Referring to Figure 4, the handset 106 comprises a superheterodyne transceiver comprising the broad-band receiver RF front end 310 having a

down-conversion unit 400, for conversion to IF, IF filtering and conversion to base-band of received signals. The superheterodyne transceiver also comprises the broad–band transmitter RF front end 312 having an up-conversion unit 402 for up-conversion and modulation of base-band signals. Although, in this example, the handset 106 comprises a superheterodyne transceiver, it should be appreciated that other transmitter, receiver or transceiver structures can be employed. However, any other transmitter, receiver or transceiver structures needs to be adaptable so that filters necessary for correct operation of the handset 106 in accordance with at least one given telecommunication standard can be easily replaced, preferably by a user of the handset 106.

Consequently, the SIM card 302 includes a filter module comprising a first bank of filters 404, a second bank of filters 406 and a bank of duplexing filters 408. The first bank of filters 404 comprises a first receiver filter 410, a second receiver filter 412 and a third receiver filter 414. An input terminal of each of the first, second and third receiver filters 410, 412, 414 is coupled to a respective first, second and third output terminal of a first receiver switch 416. An output terminal of each of the first, second and third receiver filters 410, 412, 414 is coupled to a respective first, second and third input terminal of a second receiver switch 418. An output terminal of the second receiver switch 418 is coupled to the down-conversion unit 400 via the second filter port 306.

The second bank of filters 406 comprises a first transmitter filter 420, a second transmitter filter 422 and a third transmitter filter 424. An input terminal of each of the first, second and third transmitter filters 420, 422, 424 is coupled to a respective first, second and third output terminal of a first

transmitter switch 426. An input terminal of the first transmitter switch 426 is coupled to the up-conversion unit 402 via the third filter port 308. An output terminal of each of the first, second and third transmitter filters 420, 422, 424 is coupled to a respective first, second and third input terminal of a second transmitter switch 428.

An input terminal of the first receiver switch 416 is coupled to an output terminal of a low noise amplifier 428, an input terminal of the low noise amplifier 428 being coupled to an output terminal of a second duplexer switch 434, via the second filter port 306, and an output terminal of a power amplifier 430. An input terminal of the power amplifier 430 is coupled to an output terminal of the second transmitter switch 428.

A first, second and third output terminal of the first duplexer switch 434 is respectively coupled to a first duplexing filter 436, a second duplexing filter 438 and a third duplexing filter 440. An output terminal of the first, second and third duplexing filter 436, 438, 440 are respectively coupled to a first, second and third output terminal of a first duplexer switch 432, an output terminal of the first duplexer switch 432 being coupled to the antenna array 300 via the first filter port 304.

Additionally, the base-band unit 314 is coupled to a subscriber parameter store 442 provided in the SIM card 302. Although not shown, the base-band unit 314 is also coupled to the first and second receiver switches 416, 418, the first and second transmitter switches 426, 428 and the first and second duplexer switches 432, 434 in order to control switching of filters.

Although, in the above example, a first bank of filters 404, a second bank of filters 406 and a bank of duplexing filters 408 are provided, each comprising a plurality of filters, one or more of the first bank of filters 404,

the second bank of filters 406 and the bank of duplexing filters 408 can be replaced by an appropriate respective single filter. The handset 106 is, in the above example, provided with banks of filters to enable the handset 106 to operate in accordance with more than one telecommunication standard.

It should be appreciated that reference to "ports" implies the presence, where appropriate, of more than one terminal.

In operation (Figure 5), a user possessing the handset 106 determines at least one telecommunication network in which the handset 106 is to be operated. The user then acquires the SIM card 302 having an appropriate filter module to enable operation of the handset 106 in the at least one telecommunication network. The SIM card 302 is then brought into operative coupling (step 500) with the handset 106 according to any technique known in the art. In the present example, physical coupling of the SIM card 302 to the handset 106 via the first, second and third filter ports 304, 306, 308 enables the first bank of filters 404, the second bank of filters 406 and the bank of duplexing filters 408 to be coupled to the processor 315 to enable operation of the handset 106.

Subsequently, the user selects (step 502), for example via the keypad 318, the telecommunication network in which the handset 106 is to operate. Software within the handset 106 then electronically switches (step 504) the first and second receiver switches 416, 418, the first and second transmitter switches 426, 428 and the first and second duplexer switches 432, 434 in order to connect a correct one of the first, second or third receiver filters 410, 412, 414 to the low noise amplifier 428 and the down-conversion unit 400, a correct one of the first, second and third transmitter filters 420, 422, 424 to the power amplifier 430 and the up-conversion unit 402, and a correct one of

the first, second or third duplexing filters 436, 438, 440 between the low noise amplifier 428, the power amplifier 430 and the antenna array 300.

Once the correct filters have been switched in-circuit, the handset 106 is able to transmit and receive signals (506) in the band of frequencies assigned to the selected telecommunication network operating in accordance with a corresponding telecommunication standard. If a different telecommunication standard is supported by the filtering module and is required by the user, a different network (if available) operating in accordance with the different telecommunication standard can be selected by repeating steps 502 and 404.

Although, in the above example, the user selects the telecommunication network, the handset 106 can be arranged to monitor an air interface in order to determine an available telecommunication standard. During this monitoring period, the bank of duplexing filters 408 required for FDD standards and the second bank of filters 406 are not necessary and the broad-band receiver front end 310 can function correctly without the need for the bank of duplexing filters 408 and the second bank of filters 406. Once the available telecommunication standard has been determined, the correct filters in the first bank of filters 404, the second bank of filters 406 and, if the available telecommunication standard is an FDD standard, the bank of duplexing filters 408 can be switched in.

In both of the above telecommunication standard selection techniques described above, if the SIM card 302 does not contain the correct filters required for the selected telecommunication standard, the display 316 can be arranged to display a message to the user to this effect and advise the user to obtain an appropriate SIM card from a Service Provider.

CLAIMS

1. A communication terminal comprising a broad-band transceiver and a filtering module specific to at least one communication standard, wherein the filtering module is removably coupleable with the broad-band transceiver.

2. A terminal as claimed in Claim 1, wherein the filtering module is part of a data carrier.

3. A terminal as claimed in Claim 2, wherein the data carrier is a smart card.

4. A terminal as claimed in Claim 3, wherein the smart card is a Subscriber Identity Module (SIM).

5. A terminal as claimed in Claim 1, wherein the filtering module comprises at least one receiver filter and at least one transmitter filter.

6. A terminal as claimed in Claim 1, wherein the filtering module comprises at least one duplexing filter.

7. A terminal as claimed in Claim 5, further comprising a first selection means for selecting at least one of the at least one receiver filter.

8. A terminal as claimed in Claim 5, further comprising a second selection means for selecting at least one of the at least one transmitter filter.

9. A terminal as claimed in Claim 6, further comprising a third selection means for selecting at least one of the at least one duplexing filter.

10. A data carrier comprising a filtering module specific to at least one communication standard, wherein the filtering module is removeably coupleable with a communication transceiver.

11. A method of operating a communication terminal comprising:

coupling a data carrier to the communication terminal, and

powering-up the communication terminal, the method being characterised by the steps of:

providing a filtering module with the data carrier, the filtering module being specific to at least one communication standard.

12. A method as claimed in Claim 11, further comprising the step of:

selecting a communication network, and

selecting filters within the filtering module to enable operation of the communication terminal in accordance with a communication standard from the at least one communication standard corresponding to the communication network selected.

13. A communication terminal substantially as hereinbefore described with reference to Figures 3 and 4.

14. A method of operating a communication terminal substantially as hereinbefore described with reference to Figure 5.

Fig. 1

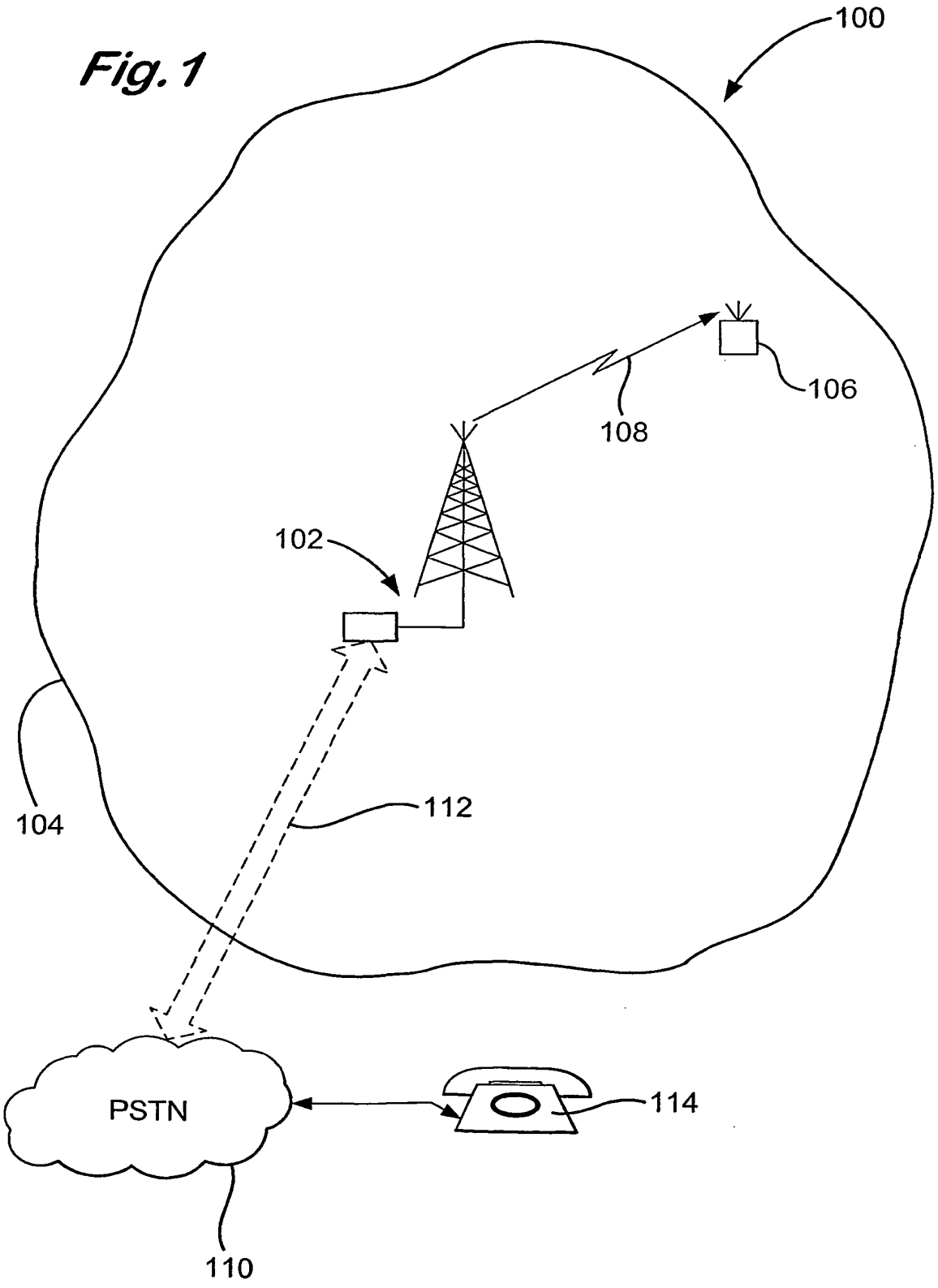


Fig.2

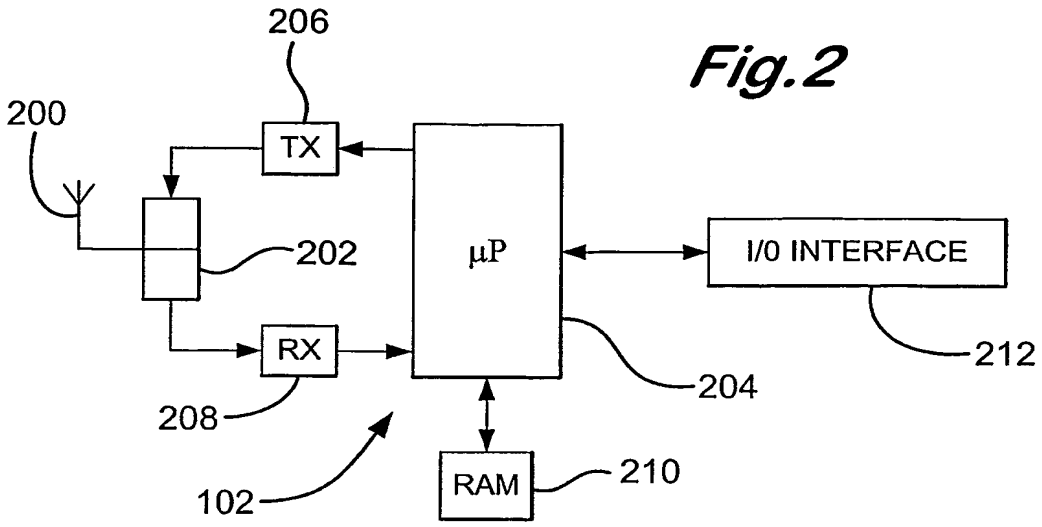

206
200
TX
202
μP
I/0 INTERFACE
RX
212
204
208
102
RAM
210

Fig.5

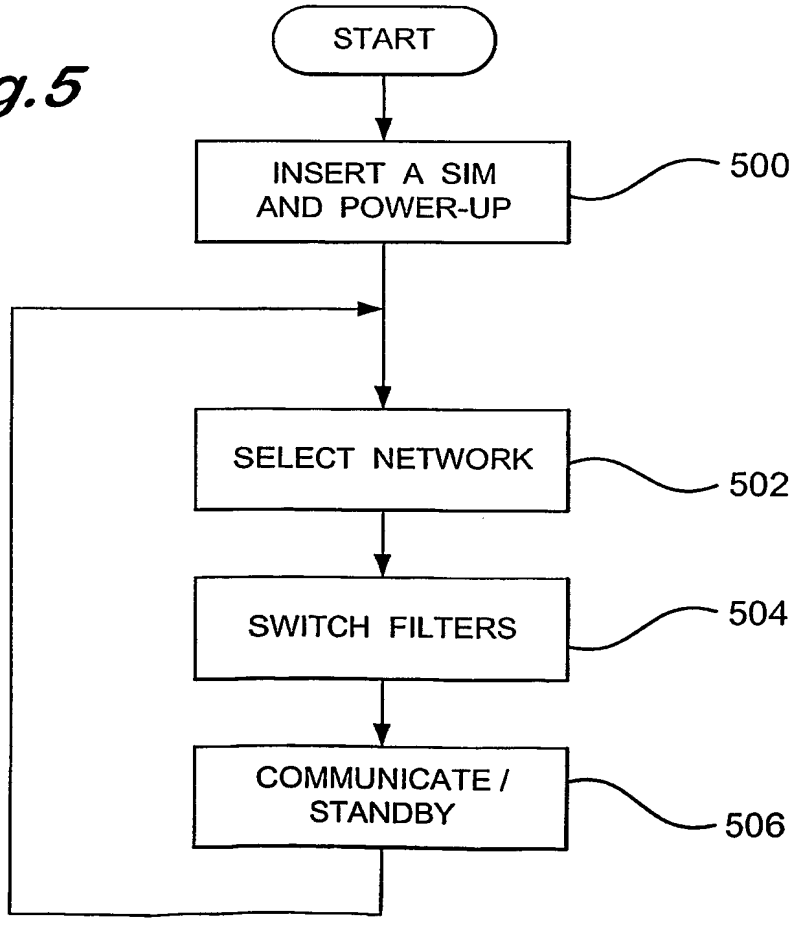

START
INSERT A SIM AND POWER-UP
500
SELECT NETWORK
502
SWITCH FILTERS
504
COMMUNICATE / STANDBY
506

Fig.3

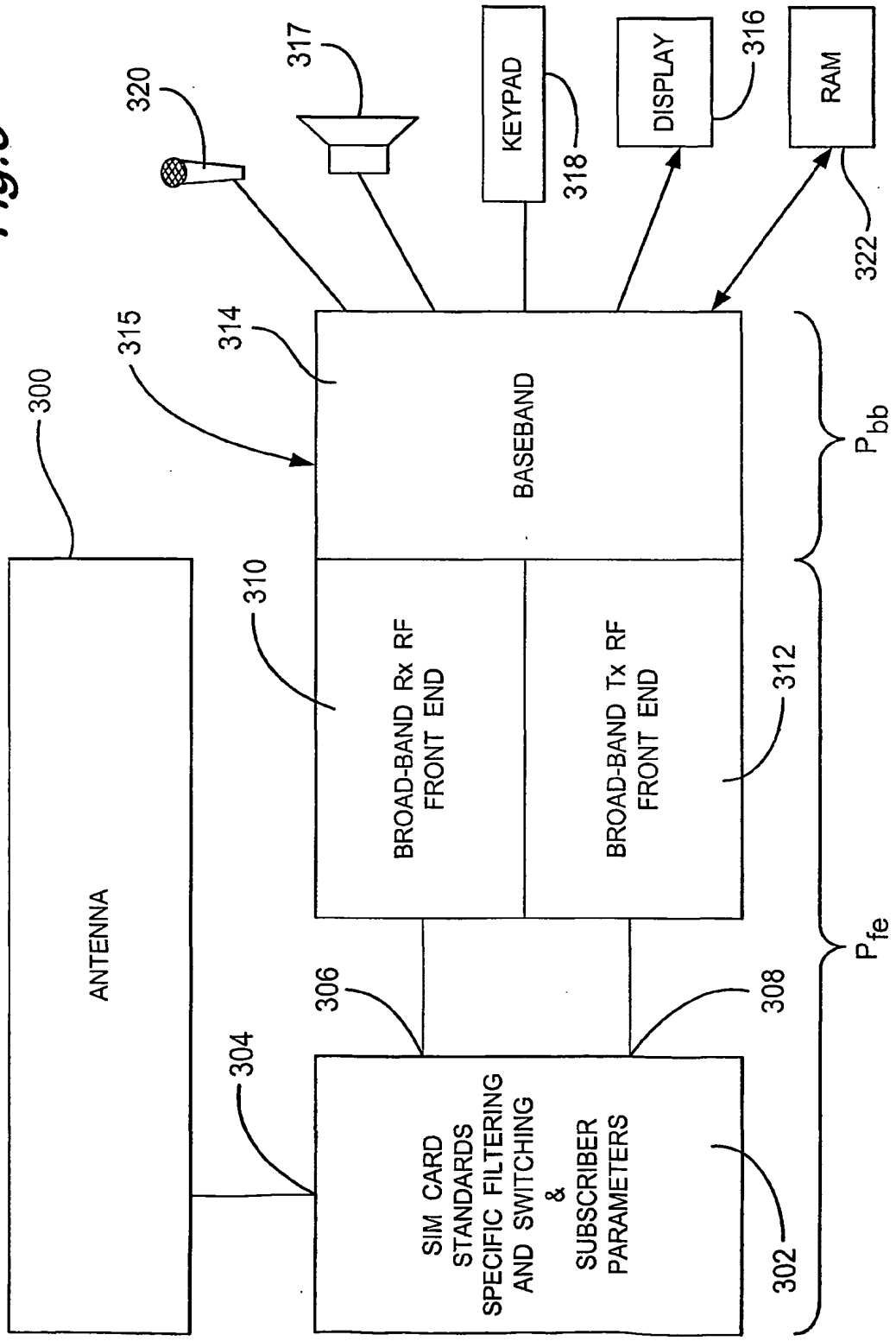
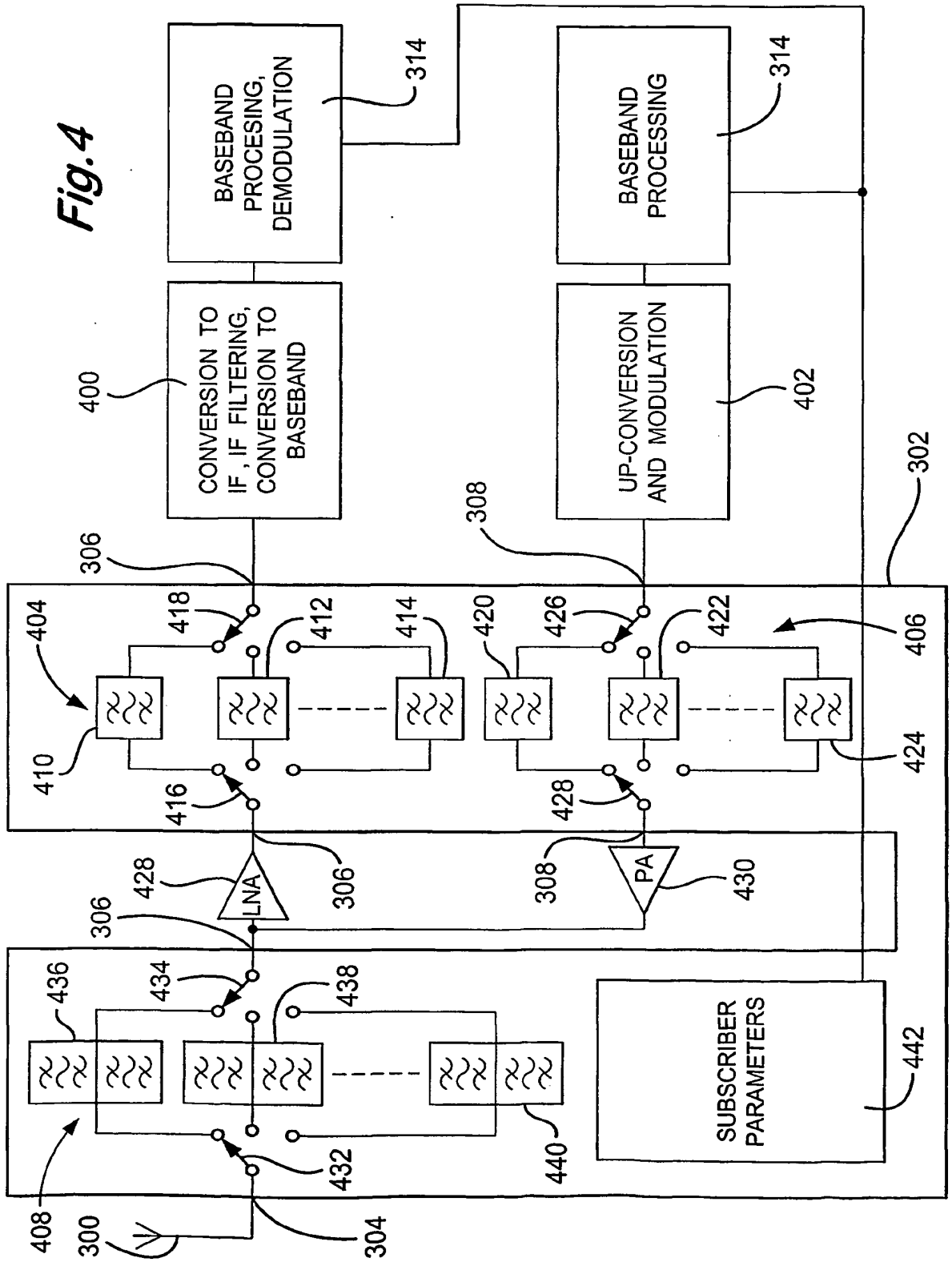

320
317
KEYPAD
318
DISPLAY
316
RAM
322
315
314
300
BASEBAND
P_{bb}
310
BROAD-BAND Rx RF FRONT END
BROAD-BAND Tx RF FRONT END
312
ANTENNA
306
308
304
SIM CARD STANDARDS SPECIFIC FILTERING AND SWITCHING & SUBSCRIBER PARAMETERS
302
P_{fe}

Fig.4


BASEBAND PROCESING, DEMODULATION
314
BASEBAND PROCESSING
314
CONVERSION TO IF, IF FILTERING, CONVERSION TO BASEBAND
400
UP-CONVERSION AND MODULATION
402
302
306
308
404
406
410
412
414
416
418
420
422
424
426
428
430
432
434
436
438
440
442
LNA
PA
SUBSCRIBER PARAMETERS
300
304
408

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 01/03128

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/32 H04B1/40

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 782 358 A (LUCENT TECHNOLOGIES INC) 2 July 1997 (1997-07-02) column 2, line 37-45 claims 1-6	1-14
A	EP 0 682 458 A (NIPPON ELECTRIC CO) 15 November 1995 (1995-11-15) column 2, line 21 -column 3, line 6	1-14
A	EP 0 829 915 A (LK PRODUCTS OY) 18 March 1998 (1998-03-18) column 3, line 49 -column 4, line 36	1-14
A	WO 99 09771 A (ERICSSON TELEFON AB L M) 25 February 1999 (1999-02-25) page 8, line 16 -page 9, line 3	1-14

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
31 July 2001	07/08/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Weinmiller, J

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 01/03128

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0782358 A	02-07-1997	JP 9205474 A	05-08-1997
EP 0682458 A	15-11-1995	JP 2586333 B	26-02-1997
		JP 7307981 A	21-11-1995
		AU 691883 B	28-05-1998
		AU 1785195 A	23-11-1995
		CA 2148673 A	14-11-1995
		KR 158785 B	01-12-1998
		US 5640686 A	17-06-1997
EP 0829915 A	18-03-1998	FI 963577 A	12-03-1998
		US 6185434 B	06-02-2001
WO 9909771 A	25-02-1999	US 6108562 A	22-08-2000
		AU 8469898 A	08-03-1999
		BR 9811188 A	25-07-2000
		CN 1274511 T	22-11-2000
		EE 200000076 A	15-12-2000
		EP 1002436 A	24-05-2000